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# (12) EUROPEAN PATENT APPLICATION

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## (54) Drilling method and means for a direct survey of geotechnical parameters

(57) On a self-moving means equipped with a rotating tower having a vertical translation device of a rotation head (1), a steel tubular body (2) is provided having axially a measure instrument to be lowered by a cable (3) driven by a winch hoist (4) to be fixed inside the tubular body (2) by means of a radial set of some projecting parts (5) inserted into a reference cavity (6) so fixing the instrument inside said tubular body (2). Said instrument is pushed in rotation downward while in its interspace (7) water is injected by a pump (8) having a duct (9) connected to the rotation head (1) of the tubular body (2). In the upper part an outside coaxial part (10) is provided to be solidly connected to the tubular body (2) having at the bottom the disgregation tool (11). A measure instrument is axially set on the outside coaxial part (10). Said measure instrument has on the upper part a collar bearing (12) and in the lower part an electronic measure element (13), formed by a drill.

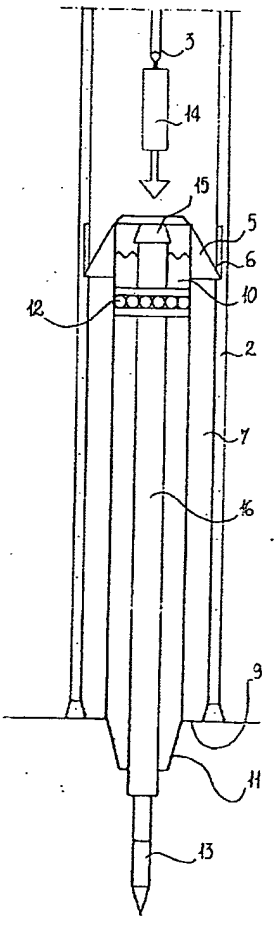


FIG.2

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## Description

[0001] The invention refers to a new ground drilling method and to a suitable means for the direct survey of geotechnical parameters. Said method characterized by using in succession a series of means that actuate step by step ground breakup and consequently greatly increase the ground penetrability grade so permitting greatest depth to be reached at a parity of the thrust given on the steel drill actuating the penetration. The invented method and the realized means are to be extremely important for example in subsidence calculus and, in general, for geologic studies on the ground on a large scale. for direct survey of the geotechnical data a method is currently known that uses a self-moving device with a rotation tower acting in combination with a cylinder actuator able to determine a thrust on a tool-holder. Said tool-holder pushes a vertical drive with an electrically-instrumented steel bit that plots, with reference to measured strength, ground resistance and water pressure of the soil. This known method allows to reach a maximum depth of 50 metres inside soft ground, depth resulting to be insufficient in particular for the above-cited calculus and studies regarding the territory. The invented method gives a solution to the problem by using a new combination means actuating an integrated effect that determines, in sequence, a rotation movement and a thrust on a steel drill arranged for the penetration and a water injection with axial emission that, together, breaking up the ground, are to greatly increase its penetrability grade. In essence the invented method provides, on a suitable self-moving means equipped with a rotating tower having a vertical translation device of a rotation head 1, a steel tubular body 2 having axially a measure instrument to be lowered by a cable 3 driven by a winch hoist 4. Said instrument to be fixed inside the tubular body 2 by means of a radial set of some projecting parts 5 that are inserted into a reference cavity 6 so fixing the instrument inside said tubular body 2. Said instrument i s pushed in rotation downward while in its interspace 7 water is injected by means of a pump 8 having a duct 9 connected to the rotation head 1 of the tubular body 2. The water falls through the interspace 7 and it flows out into the ground through the slot 9. In the upper part an outside coaxial part 10 is provided. Said part to be solidly connected to the tubular body 2 having at the bottom the disgregation tool 11. Morevoer a measure instrument is axially set on the outside coaxial part 10. The said measure instrument has on the upper part a collar bearing 12 and in the lower part a measure element 13, electronically-instrumented, which is formed by a drill for ground breaking mechanical strenght, and water pressure detection (piezocone). Said drill 13 protrudes from the tubular body 2 for about 40 centimetres so as to permit ground characteristic detection before disgregation. After having carried out the survey, the outside coaxial part is retrieved by a tool 14 supported by the cable 3. Said tool 14 enters the cylindrical body 15 and it unhooks the projecting parts 5 of the hollows 6. In an embodiment, instead of the drill 13 screwed onto the body 16, a different drill type is mounted for detection of chemical parameters or otherwise for ground sampling to be analyzed. In particular in the invented method the movement system and the water injection system are continuously monitored. Moreover the drilling parameters, like thrust energy, rotational energy, injection fluid pressure and the speed of travel in operation to the found revolution, are used together with the strength parameters measured by the drill 13 so as to directly determine the majority of ground geotechnical parameters. The suitable means to be used in the invented method is illustrated in a nonlimiting form in the drawings of sheets 1 and 2. In sheet 1 fig. 1 is schematicall shown an essential view of the self-moving means while working. In sheet 2 fig. 2 the longitudinal section view of the survey means ready to be used with the view of the upper part of the fool 14 supported by the cable 3 is shown. In realization the invented means is to be adapted according to necessity of use.

## Claims

1. Drilling method and means for a direct survey of geotechnical parameters consists of a suitable self-moving means equipped with a rotating tower having a vertical translation device of a rotation head (1); **characterized in that**

   - on the self-moving means a steel tubular body (2) is provided having axially a measure instrument to be lowered by a cable (3) driven by a winch hoist (4); said instrument to be fixed inside the tubular body (2) by means of a radial set of some projecting parts (5) that are inserted into a reference cavity (6)so fixing the instrument inside said tubular body (2); and that
   - the instrument is pushed in rotation downward while in its interspace (7) water is injected by means of a pump (8) having a duct (9) connected to the rotation head (1) of the tubular body (2); and that
   - the water falls through the interspace (7) and it flows out into the ground through the slot (9); and that
   - in the upper part an outside coaxial part (10) is provided, said part to be solidly connected to the tubular body (2) having at the bottom the disgregation tool (11); and that
   - a measure instrument is axially set on the outside coaxial part (10), said measure instrument has on the upper part a collar bearing (12) and in the lower part a measure element (13), electronically-instrumented, which is formed by a drill for ground breaking mechanical strenght, and water pressure detection, said drill (13)

protrudes from the tubular body (2) for about 40 centimetres so as to permit ground characteristic detection before disgregation; and that

- after having carried out the survey, the outside coaxial part is retrieved by a tool (14) supported by the cable (3), said tool (14) enters the cylindrical body (15) and it unhooks the projecting parts (5) of the hollows (6).

2. Drilling method and means for a direct survey of geotechnical parameters, as per claim 1, characterized in that instead of the drill (13) screwed onto the body (16), a different drill type is mounted for detection of chemical parameters or otherwise for ground sampling to be analyzed.

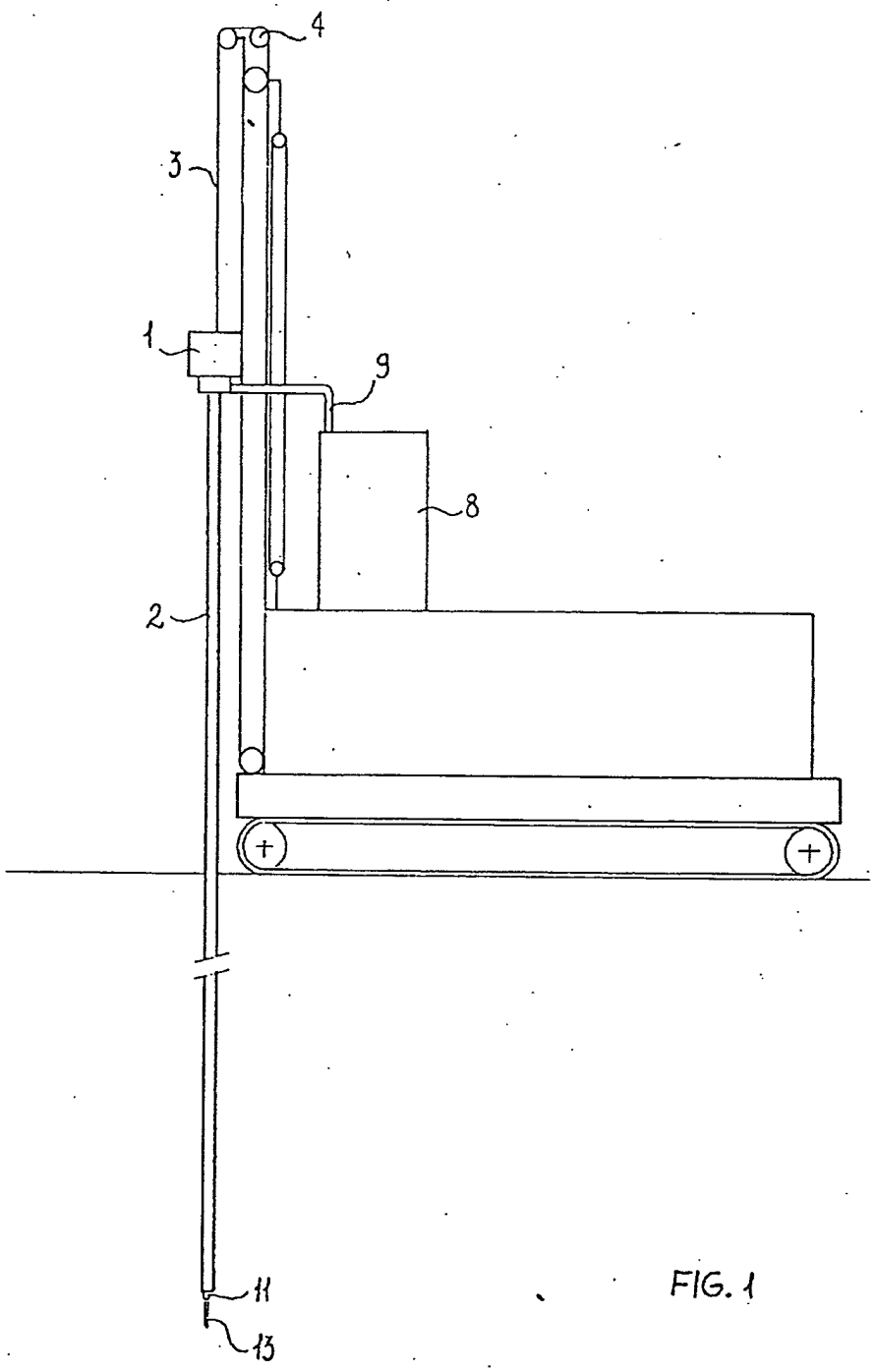


FIG. 1

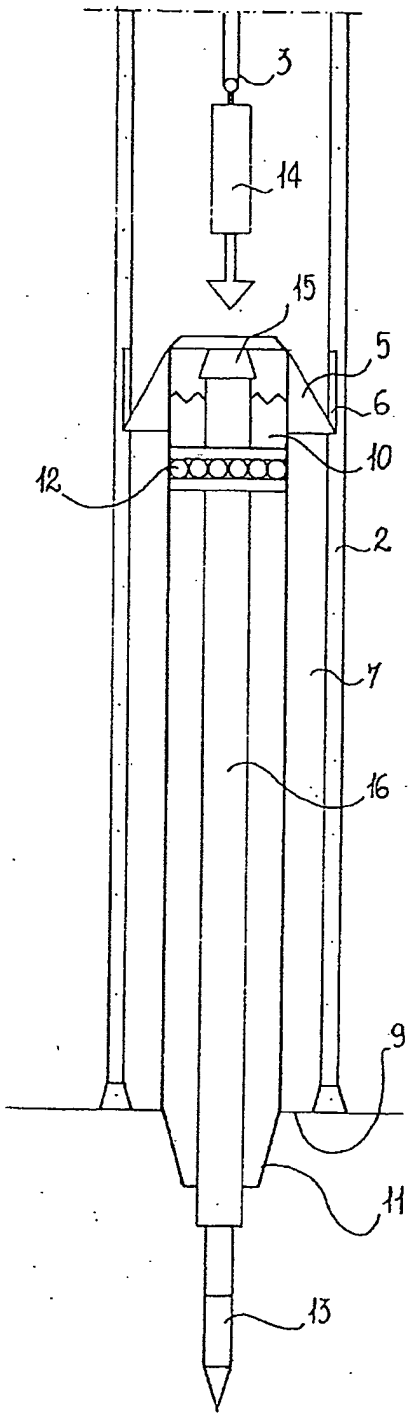


FIG.2

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# EUROPEAN SEARCH REPORT

Application Number
EP 01 11 1042

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
|---|---|---|---|
| X | US 5 475 309 A (HONG HARRY T ET AL)<br>12 December 1995 (1995-12-12)<br>* column 3, line 34 - column 4, line 59; figures 1,2,4 *<br>see: bit (18) with electronic instruments (50, 80) and interspace between (14) and (16) for water injetcion, a pump being implicitly disclosed.<br>--- | 1 | E21B47/01<br>E21B49/00<br>E02D1/02 |
| X | GB 1 433 265 A (MCCULLOGH I J)<br>22 April 1976 (1976-04-22)<br>* page 1, line 75 - page 2, line 22 *<br>* page 2, line 83 - page 3, line 84; claim 1; figures 1-3 *<br>see bit (16), Kelly (20), pump (55), electronic instrument (82), wireline (40)<br>--- | 1 | |
| X | US 4 845 493 A (HOWARD MIG A)<br>4 July 1989 (1989-07-04)<br>* column 3, line 36 - column 4, line 24; figures 1-4 *<br>Only difference from claim 1: electronic instrument (19) at the top of drilling string<br>see "mud pump and drill bit" (col. 3, l. 41), "high pressure water stream" (col. 4, l. 23) which also implies a pump<br>--- | 1 | TECHNICAL FIELDS SEARCHED (Int.Cl.7)<br>E21B<br>E02D |
| A | DE 42 30 624 A (DEUTSCHE AEROSPACE)<br>17 March 1994 (1994-03-17)<br>* column 3, line 35 - column 4, line 59; figures 1,2,4 *<br>* abstract; figure 1 *<br>----- | 1 | |

~~The present search report has been drawn up for all claims~~

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| MUNICH | 28 November 2001 | Tompouloglou, C |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 01 11 1042

## CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

## LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 01 11 1042

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claim : 1

Electronic instrument for measuring geotechnical parameters in the borehole.

2. Claim : 2

A sampler

Although claim 2 has the appearance of a dependent claim, it is an independent claims because it replaces the drill type of claim 1.
The drill type of claim 2 is conceived as a sampler

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 11 1042

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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28-11-2001

| Patent document cited in search report | | Publication date | Patent family member(s) | | Publication date |
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| US 5475309 | A | 12-12-1995 | US | 6150822 A | 21-11-2000 |
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

PATENTTI- JA REKISTERIHALLITUS VÄLIPÄÄTÖS

20.02.2004



Kolster Oy Ab

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00120 Helsinki

| | |
|---|---|
| Patenttihakemus nro: | 20030553 |
| Luokka: | E21B AH |
| Hakija: | Sandvik Tamrock Oy |
| Asiamies: | Kolster Oy Ab |
| Asiamiehen viite: | 2022321FI |
| Määräpäivä: | 20.08.2004 |

Patenttihakemuksen numero ja luokka on mainittava kirjelmässänne PRH:lle

Vaatimuksessa 1 sangen yleisessä muodossa oleva porareiän mittauslaite on tunnettu esimerkiksi US-patenttijulkaisun 5 217 075 kuvista 1-3. US-julkaisussa mittauslaitteen runkoon kuuluu pitkänomainen suojaelin 9, jonka sisään anturi 3 on siirrettävissä. Myös muissa vaatimuksissa esitetyt ratkaisut eivät eroa olennaisesti siitä, mikä on tunnettua em. julkaisusta, US-patenttijulkaisusta 5 505 259, katso esim. kuva 1, EP-hakemusjulkaisusta 1 256 692, katso esim. kuvat 1 ja 2, JP-hakemusjulkaisusta 2-112589, katso esim. kuva 1 ja US-hakemusjulkaisusta 2002/0036102, katso esim. kuva 1. Vaatimuksissa 10 ja 11 esitetyt ratkaisut, jotka koskevat voimansiirtokaapelin kelaamista säiliöön, eivät keksinnöllisessä mielessä liity muissa vaatimuksissa esitettyyn anturin, suojaelimen ja siirtoelimen muodostamaan kombinaatioon. Edellä olevan perusteella esitetyt vaatimukset eivät ole hyväksyttävissä.

Vanhempi tutkijainsinööri Antti Heikkilä
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Liitteenä tutkimusraportti ja viitejulkaisut

Lausumanne huomautusten johdosta on annettava viimeistään yllämainittuna määräpäivänä. Jollette ole antanut lausumaanne virastoon viimeistään mainittuna määräpäivänä tai ryhtynyt toimenpiteisiin tässä välipäätöksessä esitettyjen puutteellisuuksien korjaamiseksi, jätetään hakemus sillensä (patenttilain 15 §). Sillensä jätetty hakemus otetaan uudelleen käsiteltäväksi, jos Te neljän kuukauden kuluessa määräpäivästä annatte lausumanne tai ryhdytte toimenpiteisiin esitettyjen puutteellisuuksien korjaamiseksi ja samassa ajassa suoritatte vahvistetun uudelleenkäsittelymaksun. Jos lausumanne on annettu virastoon oikeassa ajassa, mutta esitettyjä puutteellisuuksia ei ole siten korjattu, että hakemus voitaisiin hyväksyä, se hylätään, mikäli virastolla ei ole aihetta antaa Teille uutta välipäätöstä (patenttilain 16 §). Uusi keksinnön selitys, siihen tehdyt lisäykset ja uudet patenttivaatimukset on aina jätettävä kahtena kappaleena ja tällöin on otettava huomioon patenttiasetuksen 19 §.

*Maksu perustuu kauppa- ja teollisuusministeriön antamaan asetukseen 1027/2001 Patentti- ja rekisterihallituksen maksullisista suoritteista muutoksineen.*

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| PATENTTIHAKEMUS NRO | LUOKITUS, IPC7 |
|---|---|
| 20030553 | E21B47/01 |

**TUTKITUT PATENTTILUOKAT (luokitusjärjestelmät ja luokkatiedot)**

**TUTKIMUKSESSA KÄYTETYT TIETOKANNAT**

Epodoc

**VIITEJULKAISUT**

| Kategoria*) | Julkaisun tunnistetiedot ja tiedot sen olennaisista kohdista | Koskee vaatimuksia |
|---|---|---|
| X,Y | US 5 217 075 A (WITTRISCH), 8.6.1993, esim. kuvat 1-3 | 1 - 18 |
| X,Y | US 5 505 259 A (WITTRISCH et. al.), 9.4.1996, esim. kuva 1 | 1 - 18 |
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| Y | US 2002/0036102 A1 (AHTOLA), 28.3.2002, esim. kuva 1 | 14 - 16 |

**Jatkuu seuraavalla sivulla** ☐

*) X Julkaisu, jonka perusteella keksintö ei ole uusi tai ei eroa olennaisesti ennestään tunnetusta tekniikasta.
Y Julkaisu, jonka perusteella keksintö ei eroa olennaisesti ennestään tunnetusta tekniikasta, kun otetaan huomioon tämä ja yksi tai useampi samaan kategoriaan kuuluva julkaisu yhdessä.
A Yleistä tekniikan tasoa edustava julkaisu.

O Tullut julkiseksi esitelmän välityksellä, hyväksikäyttämällä tai muutoin muun kuin kirjoituksen avulla.
P Julkaistu ennen hakemuksen tekemispäivää mutta ei ennen aikaisinta etuoikeuspäivää.
T Julkaistu hakemuksen tekemispäivän tai etuoikeuspäivän jälkeen ja valaisee keksinnön periaatetta tai teoreettista taustaa.
E Aikaisempi suomalainen tai Suomea koskeva patentti- tai hyödyllisyysmallihakemus, joka on tullut julkiseksi hakemuksen tekemispäivänä (etuoikeuspäivänä) tai sen jälkeen.
D Julkaisu, joka on mainittu hakemuksessa.
L Julkaisu, joka kyseenalaistaa etuoikeuden, osoittaa toisen julkaisun julkaisupäivämäärän tai johon viitataan jostakin muusta syystä.

& Samaan patenttiperheeseen kuuluva julkaisu.

**Lisätietoja liitteessä** ☐

| Päiväys | Tutkijainsinööri |
|---|---|
| 20.2.2004 | Antti Heikkilä |